

PSG PLASTIC SERVICE GMBH

Pirnaer Str. 14-16

68309 Mannheim

Germany

Tel.: (+49.621) 71 62 -0

Fax : (+49621) 71 62 -162

Operating instructions

ETR 90

Compact temperature control unit

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1. General

The ETR 90 / 92 temperature control unit is an ultra-modern micro-processor device. It provides a large number of functions but takes up very little space. Great importance was placed during its development on making it easy to operate.

These instructions contain all the information necessary for starting up and operating this unit.

It is set in the factory at a number of settings which will be fully adequate for all normal applications. However, if you wish to change any of them you will need to change the configuration of the unit.

You can see how to do this from the separate set of instructions on configuration. For the normal user, the configuration is "locked away" inside the unit by means of a wiring bridge. The configuration should only be changed by knowledgeable experts.

1.1 Technical data

Micro-processor control unit for one temperature zone

Size: 48 x 96 mm, 190 mm deep (to comply with DIN 43700)

Mains power supply

230 V, 50 / 60 Hz ($\pm 10\%$), convertible to 115 V AC.

Input: 1 measurement sensor

Fe.CuNi (L): 0 - 500°C (32 - 900°F)

Fe.CuNi (J): 0 - 500°C (32 - 900°F)

Ni-CrNi (K): 0 - 900°C (32 - 1300°F)

Pt 100: 0 - 500°C (32 - 900°F)

The unit complies with DIN 43700 and DIN IEC 574

Automatic temperature compensation

Protected against sensor breakage and reversing of poles.

Input 2 can at choice also be used for monitoring electric current via a current converter or addressing resistance in interface operation.

Outputs:

Output 1 Heating

Output 2 Cooling or Alarm

Output 3 Alarm

- Open collector 9V / 20 mA for thyristor or solid-state relays

- Solid-state relay 230 V AC / min 10 mA, max. 100 mA for output protection

- Analogue 0 - 10 V or 0 - 20 mA for constancy actuators (only Outputs 1+2)

Interface

Serial 150 to 19200 Baud via module as:

- passive 20 mA current loop (TTY)
- passive 20 mA current loop (TTY) 4-wire
- RS232 interface
- RS485 interface

A choice of protocols is available.

Required value entry

Digital via keyboard or interface

Actual value display Digital via 7-segment display

Control panel

Two 4-figure 7-segment displays (required and actual values)

One 1-figure 7-segment information display

Six status LED's, 4 keys, foil covered

Control behaviour

Extended digital PID algorithm, separate for heating and cooling, automatic structure change-over (PD, PID, PI).

Approach adaptation to parameter requirement in the approach phase, facility for manually reading out and adjusting control parameters.

Housing

Robust, shock-resistant steel plate housing

Insulation tension

Mains electronics: 1.5 kV

Test voltage: 2.5 kV

Connecting terminals

16-pole screw terminals, maximum 1.5

2. Display and control panel

Actual value (normal operation)	Required value (normal operation)
Parameter - abbreviation	Parameter - value
Status - display (yellow) o = heating, * = cooling 1 = channel 1, o = no function	
Alarm message (red) ((= GW-, temperature too low) = GW+, temperature too high A = Mains power alarm	Information display for: - unit (C, F) - Operator's list (L) - parameter list (P)
Manual key with yellow LED (controller operation, power acceptance)	Scroll key (call up Operator's List, "scrolling" parameter)
"Less" key (reduce parameter)	"More" key (increase parameter)

2.1 Keys

A function is allocated to each of the keys, and additional functions can be called up by means of combinations of keys. These can be selected by pressing two keys simultaneously.

Key	Function
<More>	Enlarges parameter value
<Less>	Reduces parameter value
<Scroll>	Scrolls to next parameter; calls up Operator's List
<Manual>	Switches from automatic to controller (manual) operation
<Scroll / Less>	Back to the basic "standard mode" level
<Scroll / Manual>	Call up parameter list
<Scroll / More>	Scrolls to preceding parameter

2.2 Displays

The unit has two 4-figure digital displays and one information display. The actual value is shown in the upper digital display and the required value in the lower one (when in basic position).

If values are entered in the control unit, the parameter abbreviation (e.g. "Set" for required value) is displayed in the upper display and the relevant parameter value in the lower one.

The information display shows which operating level has been selected. In the basic position, the units ($^{\circ}\text{C}$ or $^{\circ}\text{F}$) are displayed here. Other information displayed here is:

L = Control unit is in the "Operator's List" mode

°L = Entry bar has been removed on the Operator's List

P = Control unit is in the "Parameter List" mode

°P = Entry bar has been removed on the Parameter List

The entry bar is lifted when an additional dot is displayed at top left (this does not apply when °C or °F is displayed).

2.3 Status LED's

The unit has 6 LED's, which indicate the following:

- Output display

Yellow LED's for automatic heating and cooling outputs. The LED is off when the heating / cooling is switched off; if it comes on and remains on, heating / cooling is running at the maximum rate. Flashing indicates the relevant gradient between 0 % (off) and 99 % (on).

- Alarm message

The red LED's are on when there has been an alarm. <= Alarm 1 (e.g. limit value minus, >= Alarm 2 (limit value plus), A = mains power alarm (e.g. when heating current is being monitored).

- Manual

The yellow LED with a picture of a hand is off when the unit is running on automatic. It comes on when the unit is in manual (controller) operation. In adaptation mode, i.e. when the unit is calculating the parameters for automatic operation, the LED with the hand flashes.

3. **Operation in general**

It is important to know all the general operational steps in order to be able to use this unit without difficulty. These are described in this section.

3.1 Operator levels

In order to separate the major settings from the minor ones, the unit is divided into three operator levels.

a) Basic level / standard mode

As soon as the unit is switched on it will be in this operating mode. The upper display will show the actual value and the lower value the required value. After having been switched to any other operating level, the unit will automatically return to this basic setting after 30 seconds if no key has been touched. The key combination <Scroll / Less> enables this return move to be made at any convenient time.

b) Operator's List / standard functions

The Operator's List is called up by pressing the <Scroll> key. The abbreviation for the parameter selected appears in the upper display, and the relevant parameter value in the lower one. The information display shows "L" for Operator's List. The Operator's List consists of a maximum of the following parameters:

Grd = Gradient
AL1 = Alarm 1
AL2 = Alarm 2
ACr = Actual current
RCr = Required current
CrT = Current tolerance.

The parameters that can be called up varies from one version of the unit to another. The parameters for current, for instance, are only active if the heating current monitoring facility has been built in.

Within the Operator's List, it is possible to scroll forwards with the <Scroll> key, or back to the previous parameter with <Scroll / More>.

c) Parameter list/additional functions

In order that additional parameters can be called up, the parameter list has to be called up by pressing the <Scroll/Manual> keys both at once.

From this list, normally only the parameter.

Grd = Temperature gradient

can be called up, although with certain version of the unit other parameters can be called up as well. A complete list of parameters is included in the Appendix. Within the parameters list it is possible to page forwards with the <Scroll> key, or back to the previous parameter with the key combination <Scroll/More>.

3.2 Entry bar

It is only possible to change values in the control unit if the entry bar has first been raised. To do this, press the <More> key and then the <Less> key. The information display indicates that this has been done by showing a dot (top left).

3.3 Changing values

Parameters can be changed in the lower display by means of the <More> and <Less> keys. The entry bar must first be raised to permit this. The <More> key is pressed to increase values and the <Less> key to decrease them.

Press <More> key	=	increase value in steps
Press <More> key and hold it down	=	increase value quickly
Press <More> key and then <Less> as well	=	increase value very quickly
Press <Less> key	=	Decrease value in steps
Press <Less> key and hold it down	=	Decrease value
quickly		
Press <Less> key and then <More> as well	=	Decrease value very quickly

4 Operating steps

4.1 Changing required values

The required value is shown permanently in the lower display when the unit is at the basic level. The following steps have to be followed to change them:

- Remove the entry bar by pressing first the <More> and then the <Less> key (an additional dot will appear in the information display). "Set" will appear in the upper display.
- Change the value with the <More> / <Less> key.
- Confirm the entry by pressing the <Scroll> key.

The required value can only be altered within a pre-determined range.

4.2 Gradient

The gradient is shown in %, and is a measure of the heating or cooling output being achieved. Full heating output is shown as a gradient of 99%, and the full cooling output as a gradient of -99%. To call up the gradient:

- Select the Operator's List by pressing <Scroll> ("L" appears in the information display)
- Call up "Grd" in the upper display by pressing the <Scroll> key again.

The gradient will be continually up-dated, and after 30 seconds the display will automatically return to the basic setting. The key combination <Scroll / Less> will return the unit to the basic position again immediately.

4.3 Alarm / limit values

There are two limit values, AL1 and AL2, in the unit. These will normally be interpreted as Limit Value Plus and Limit Value Minus. They can be changed as follows:

- Select Operator's List by pressing <Scroll> ("L" appears in the information display)
- Select "AL1" or "AL2" by pressing the <Scroll> key the necessary number of times
- Remove the entry bar by pressing first the <More> and then the <Less> key (an additional dot will appear in the information display). "Set" will appear in the upper display.
- Change the value with the <More> / <Less> key.
- Confirm the entry by pressing the <Scroll> key again.

4.4 Heating current monitor

The heating current monitor facility is not built in to all versions of this unit. The heating current is measured by the unit via a current converter and compared with the required value for current. If the actual value deviates from the required value by more than the pre-set tolerance, an alarm message is issued. There will also be an alarm message if current continues to flow when the heating unit has been switched off. The following operational steps are necessary for monitoring the heating current:

- a) Reading out the actual value for current
 - Select Operator's List by pressing <Scroll> (an "L" appears in the information display).
 - Select the "ACr" parameter for actual current by pressing the <Scroll> key again. The value will be shown in amperes as measured via the current converter when the heating is switched on. This value can only be displayed.
- b) Accept required value for current
 - Select Operator's List by pressing <Scroll> (an "L" appears in the information display).
 - Select the parameter "RCr" for required current by pressing the <Scroll> key again. When the heating is switched on, this value will be compared with the actual current. The required current can be accepted automatically by the unit; this must be done once when the unit is being started up. For this purpose, "RCr" must appear in the upper display.
 - Remove the entry bar by pressing first the <More> and then the <Less> key (an additional dot will appear in the information display).
 - Press the <Manual> key; the symbol "Acc" (for "acceptance" of the required value for current) will appear briefly.
- c) Set the tolerance value for current
 - Select Operator's List by pressing <Scroll> (an "L" appears in the information display).
 - Select the "CrT" parameter by pressing the <Scroll> key the necessary number of times. If the actual value deviates from the required value by more than the pre-set tolerance, an alarm message will be issued.

A value must be set for current tolerance, and it should be about 10 to 20% of the actual value for current. To set the tolerance value:

- Remove the entry bar by pressing first the <More> and then the <Less> key (an additional dot will appear in the information display).
- Change the value with the <More> / <Less> key.
- Confirm the entry by pressing the <Scroll> key.

4.5 Adaptation

Adaptation is the term used for the process by which the necessary control parameter is calculated automatically for the control unit ("self-optimisation"). This process runs entirely separately and automatically, but it has to be set off manually when the unit is first started up on a new or change control point.

- a) Start adaptation
 - Remove the entry bar by pressing first the <More> and then the <Less> key (an additional dot will appear in the information display). "Set" will appear in the upper display.
 - Select "AdA" by pressing the <Manual> key.
 - The lower display will normally be showing OFF. This is changed to ON by pressing the <Less> key so that adaptation can start.
 - Confirm the entry by pressing the <Scroll> key.

- "Set" will now appear in the upper display and the new required value can be entered.
- Change the value (if necessary) with the <More> / <Less> key. The new required value should be at least 40°C above the current actual value (or 30°C below it in the case of cooling adaptation).
- Confirm the entry by pressing the <Scroll> key.

Caution:

In order to avoid any mistakes in adaptation, the required value cannot be changed while adaptation is running. If the required value is changed, adaptation is suspended and the unit continues to work with the previous control parameters.

b) Terminating adaptation

The adaptation cycle automatically comes to an end when the parameters have been calculated. It is not normally necessary to terminate.

- Remove the entry bar by pressing first the <More> and then the <Less> key (an additional dot will appear in the information display).
- Select "AdA" by pressing the <Manual> key.
- Change "ON" in the lower display to "OFF" by pressing the <Less> key.
- Confirm the entry by pressing the <Scroll> key.

5 Main functions / explanations

5.1 Sensor breakage / controller operation

In the event of a sensor breaking, the region under control can continue to be controlled at the gradient last saved in the memory. This makes emergency operation possible. If the lead from the sensor breaks, "Sb" will appear in the upper display.

a) Switching to controller operation

If "Sb" appears in the display, the sensor connected to the unit has broken. The lower display goes out, and the pre-set required value can no longer be adjusted. If a sensor breaks, the heating and the cooling are shut off. To switch over to controller operation:

- Select Operator's List by pressing <Scroll> (an "L" appears in the information display).
- Select the parameter "Grd" by pressing the <Scroll> key the necessary number of times, it is not already shown in the upper display.
- Remove the entry bar by pressing first the <More> and then the <Less> key (an additional dot will appear in the information display).
- Press <Manual> and the unit will switch over to controller (manual) operation. The yellow LED will appear in the key with the hand. The gradient issued and shown under the "Grd" parameter will be equal to the average gradient most recently run in automatic operation.
- The gradient issued can be corrected by means of the <More> and the <Less> keys.
- Confirm the entry by pressing the <Scroll> key.

- At the basic level, which can be reached with the key combination <Scroll / Less>, "Sb" will appear in the upper display and the current gradient in the lower display.

b) Switching off controller operation

When the sensor of the control unit has been repaired, controller (manual) operation must be switched off again. This can be done by switching the unit off and then on again, or:

- Select Operator's List by pressing <Scroll> (an "L" appears in the information display).
- Select the parameter "Grd" by pressing the <Scroll> key the necessary number of times, it is not already shown in the upper display.
- Remove the entry bar by pressing first the <More> and then the <Less> key (an additional dot will appear in the information display).
- Press <Manual> and the unit will switch back to automatic operation, but only if the sensor has been properly repaired. The LED in the key with the hand will not come on.

6. Commissioning / installation

6.1 Allocation of terminals

1) Outputs 1, 2, 3

TS, constant or SSR

With TS and constant, check polarity

2) Interface

With TTY (20 mA) 2-lead and RS485, as illustrated.

With TTY (20 mA) 4-lead, output 3 is used for interface

RXD + on 8

RXD - on 9

TXD + on 10

TXD - on 11

With RS232:

GND on 9

TXD on 10

RXD on 11

3) Input 2, current converter connection for monitoring current

In interface operation and current monitoring, the control unit address is set via keyboard on the unit. In interface operation without monitoring of current, resistances can be addressed via the current inputs. The following values apply:

Address 0 = no resistance

Address 1 = terminals 12 + 13 bridged

Address 2 = 1.3 kOhm

Address 3 = 1.78 kOhm

Address 4 = 2.87 kOhm

Address 5 = 3.92 kOhm

Address 6 = 5.11 kOhm

Address 7 = 6.81 kOhm

Address 8 = 8.06 kOhm

Address 9 = 11.5 kOhm

Address 10 = 14.3 kOhm

...

All resistances: metal layer < 1%

7 Works settings / parameters

The units are set in the works at values which will be suitable for most normal areas of operation. For the sake of completeness, however, these works settings are listed below and if any changes have to be made a separate set of configuration instructions can be provided.

Operator's List L: (for all standard versions)

Symbol	Explanation	Setting	Units
Set	Required value	020	°C
Grd	Gradient	00	%
AL1	Alarm 1	010	°C
AL2	Alarm 2	010	°C
ACr	Actual current	00.0	A
CrT	Current tolerance	05.0	A
RCr	Required current	00.0	A

a) **ETR 90 / SR / 0 / GSR / 500°C / Fe / O / O**

Symbol	Attribute	Setting	Units	
Pb	--	2.0	%	1) Betriebsart (btA?)
Td	--	15	sec	St = 0
Ti	--	60	sec	St- = 0
Ta	--	10	sec	rE = 1
Pb	--	3,0	%	rE- = 0
Td-	--	120	sec	lin = 0
Ti-	--	10	sec	FbA = 0
Ta-	--	OFF	sec	PAS = 0
AdA	A P	000		3 P = 0
Adr	--	9.6		2) Systemeinstellung (Sys?)
bd	--	00	kbaud	CEL = 1
Pro	--	look 1)		SbF = 0
btA?	--	look 2)		Su = 0
Sys?	--	look 3)		An4 = 0
Adp?	--	99		Par = 0
Sb	--	99	%	tsp = 0
Sb-	--	500	%	
Soo	--	000	°C	3) Adoptionsart (Adp?)
Sou	--	00.0	°C	Apb = 1
rAP	--	A3.1	°C/min	AAF = 0
AS1	--	A2.1	°C	AA- = 0
AS2	--	00	°C	
OFF	--	FEL	°C	

Sen	- -			
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b) **ETR 90/TS/0/GSR/500°C/Fe/StA/0**

Symbol	Attribute	Setting	Units	
Pb	--	1.0	%	1) Betriebsart (btA?)
Td	--	10	sec	St = 0
Ti	--	40	sec	St- = 0
Ta	--	00	sec	rE = 1
Pb	--	3,0	%	rE- = 0
Td-	--	30	sec	lin = 0
Ti-	--	120	sec	Fba = 0
Ta-	--	10	sec	PAS = 0
AdA	A P	OFF		3P = 0
Adr	--	000		2) Systemeinstellung (Sys?)
bd	--	9.6	kbaud	CEL = 1
Pro	--	99		SbF = 0
btA?	--	look 1)		Su = 0
Sys?	--	look 2)		An4 = 0
Adp?	--	look 3)		Par = 0
Sb	--	99	%	tsp = 0
Sb-	--	99	%	
Soo	--	500	°C	3) Adoptionsart (Adp?)
Sou	--	000	°C	Apb = 1
rAP	--	00.0	°C/min	AAF = 0
AS1	--	A3.1	°C	AA- = 0
AS2	--	A2.1	°C	
OFF	--	00	°C	
Sen	--	FEL		

c) **ETR 90/SR/KSR/GSR/500°C/Fe/StA/0**

Symbol	Attribute	Setting	Units	
Pb	--	2.0	%	1) Betriebsart (btA?)
Td	--	15	sec	St = 0
Ti	--	60	sec	St- = 0
Ta	--	10	sec	rE = 1
Pb	--	3,0	%	rE- = 1
Td-	--	30	sec	lin = 0
Ti-	--	120	sec	Fba = 0
Ta-	--	10	sec	PAS = 0
AdA	A P	OFF		3P = 1
Adr	--	000		2) Systemeinstellung (Sys?)
bd	--	9.6	kbaud	CEL = 1
Pro	--	00		SbF = 0
btA?	--	look 1)		Su = 1
Sys?	--	look 2)		An4 = 0
Adp?	--	look 3)		Par = 0
Sb	--	99	%	tsp = 0
Sb-	--	99	%	
Soo	--	500	°C	3) Adoptionsart (Adp?)
Sou	--	000	°C	Apb = 1
rAP	--	00.0	°C/min	AAF = 0
AS1	--	A3.1	°C	AA- = 0
AS2	--	A2.1	°C	
OFF	--	00	°C	
Sen	--	FEL		